Conference Reports

The Sixth International Conference on Ecobalances

Development and Systematizing of EcoBalance Tools Based on Life-Cycle-Thinking

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Introduction

The Sixth International Conference on Ecobalance (the 6th-ICEB) was held during October 25–27, 2004 at the International Conference Center 'Epochal', Tsukuba, Japan, sponsored by

- The Society of Non-Traditional Technology,
- National Institute for Agro-Environmental Sciences,
- Japan Environmental Management Association for Industry,
- Center for Environmental Information Science,
- in cooperation with United Nations University.

It was actually the **ten-year anniversary** of Ecobalance Conferences, which started in 1994 and has biannually provided a platform for international exchange for methodological and practical studies on Life Cycle Assessment (LCA). The main theme of the 6th-ICEB was 'Development and Systematizing of EcoBalance tools based on Life-Cycle-Thinking' which was presented as the sub-title of the 6th-ICEB. The scope of the conference was to reconsider and focus on the 'Life-Cycle-Thinking', the core essence of the Ecobalance conference. The 6th-ICEB aimed at discussing how the new concepts and tools that have been developed during this decade could be linked to the Life-Cycle-Thinking and how Life-Cycle-Thinking could be implemented in decision-making for companies, consumers and governments.

The 6th-ICEB attracted over 400 participants to the three-day event. In addition to participants from large firms, academics, consultants and representatives from private research institutes were presented. There was also a sampling of small enterprises and government representatives as well as NGOs. The attendance included 105 foreign participants from twenty-five countries; the largest number of delegates was 31 from Thailand followed by Korea, Germany, Italy, Sweden, Switzerland, Canada, The Netherlands, Mexico, USA, Australia, Belgium, China, India, Brazil, Chile, France, Indonesia, Malaysia, Mongolia, Norway, the Philippines, Poland, Singapore, Taiwan.

The sessions of the 6th ICEB were arranged by the program committee, whose details are shown in **Table 1** with the number of presentations. There were in total 118 oral presentations in three sessions, divided into 19 sub-sessions, during three days. In addition, 97 posters, in a separate afternoon poster session, were presented at the conference.

The conference was connected to the AIST Workshop entitled 'The 4th AIST Workshop on 'LCA for APEC Member Economies – Capacity Building in the region' (October 26th and 27th), in cooperation with The Global Alliance for Lifecycle Assessment Centers (GALAC) and the UNEP/SETAC Life Cycle Initiative.

Table 1: Sessions and the number of presentations in the 6th ICEB

Main category	Sub-sessions for oral presentations	No. of oral presentations	No. of poster presentations
Opening plenary		1	
S1: Life cycle assessment	S1-1: LCIA; Risk Analysis and Others	4	39
	S1-2: Agriculture	4	
	S1-3: LCI methodology	8	
	S1-4: Advanced LCA Case Study-1	6	
	S1-5: LCIA; Damage Assessment	9	
	S1-6: Advanced LCA Case Study-2	7	
	S1-7: Database and Software	8	
	S1-8: Waste Management	5	
S2: Application of life-cycle-thinking to analyses/ assessments of technologies, products and services	S2-1: Material Flow Analysis	4	39
	S2-2: Life Cycle Costing	5	
	S2-3: Design for Environment	7	
	S2-4: Eco-efficiency	8	
	S2-5: Eco-material	8	
	S2-6: Technology Systems	5	
S3: Application of life-cycle-thinking to decision-making by governments, enterprises, and consumers	S3-1: Decision Support Tools in Environmental Policy	9	19
	S3-3: Industrial Ecology	4	
	S3-4: Material Flow Cost Accounting	8	
	S3-5: Consumer Behavior and the Environment	8	
	Total	118	97

This conference review paper introduces the opening, plenary and closing sessions focusing mainly on the session summaries to illustrate the results of the conference.

Opening Plenary and Panel Discussion

Dr. Atsushi INABA of AIST, the chairman of the executive committee, opened the conference by noting that the 6th ICEB was the ten-year anniversary of Ecobalance conferences. Ecobalance conference has grown to become one of the largest LCA-related international conferences and has attracted a lot of participants from many countries. He also tendered his acknowledgment to Dr. HALADA of NIMS, who organized the first ICEB in 1994 and has contributed to ICEB repeatedly.

In the afternoon of the first day, an opening plenary and panel discussions were held. Prof. Itaru YASUI of United Nations University, who chaired the organizing committee, gave a talk in commemoration of the 10 years anniversary of Ecobalance conferences. He rationalized the number of participants, presentations and the main themes of the 1st to 6th Ecobalance conferences. There have been many developments of LCA and its related tools. These tools are based on Life-Cycle-Thinking and may lead us to 'Sustainable human activities' as well as a 'Sustainable earth'. He explained that there are four stages of development and 'decoupling' of environmental issues in each country, 1st stage: destructive use of ecosystem, 2nd stage: damage by pollution and causalities by natural disaster, 3rd stage: waste generation, 4th stage: material and energy consumption. He concluded that advanced countries are in the 4th stage of development, and it is time to change our way of thinking. All the LCA-related tools should lead to human development to enlarge people's choices, to create an enabling environment for people to enjoy long, healthy and creative lives. In other countries, the stage varies and LCA may be applicable in different ways.

Prof. Masayasu KITAGAWA of Waseda University, the former governor of Mie Prefecture in Japan, gave a keynote lecture. While he was the governor of Mie Prefecture, he made great efforts to advance restructuring of legislations and institutions in his region and succeeded in raising people's environmental awareness. For example, he made a pledge to eliminate waste in the prefecture office altogether and introduced a new local tax on industrial waste. It was not a graduated reduction, but a single-step, zero-emission commitment. At first prefecture officials said it was not realistic and industries strongly objected. However, they finally spontaneously adapted and made the change. As a result, the Mie prefecture Government acquired ISO 14001 certification and prefecture employees' awareness of environment was further increased. The industries also came to realize that a reduction of waste would be beneficial for themselves. Prof. Kitagawa also mentioned that business activities have started experiencing a shift in which both labor productivity and resource productivity are brought into view. He succeeded in inviting to set up an LCD plant of the SHARP Co., Ltd. in his region and expects 450 billion in annual sales and 12 thousand employments. This indicates the shift to fine chemical industry in the region where it was mainly dependent on petrochemical industrial complex. His concluding remarks were very interesting. He was awarded the grand prize in the annual buzzwords-of-the year contest for 'Manifest' last year. He proposed that the audience, who is involved in LCA, should 'manifest' what he or she thinks it is scientifically true.

Following Prof. Kitagawa's keynote lecture, the panel discussion took place. The target was to discuss the role of governments, industries and consumers for promotion of Life-Cycle-Thinking in decision-making.

Prof. Ryoichi YAMAMOTO of University of Tokyo mentioned that comprehensive socio and environmental economic polices for sustainable economy should be established so that massive eco-action would be enhanced in the society. For example, eco-design should be mandatory by law. He emphasized that the introduction of Life-Cycle-Thinking in policy-making and sustainability communications with all stakeholders are quite important. Green procurements should be based on LCA. He pointed out that there is a discrepancy between WTO agreements and LCA, which must be solved in the future. Finally Prof. Yamamoto suggested that social impact assessment methodology based on Life-Cycle-Thinking should be developed.

Dr. Matthias FINKBEINER of DaimlerChrysler, who is well known as co-convener of ISO TC207/SC5 working group on the revision of the ISO 14040 series of standards, talked about the beauty of LCA and challenges. He emphasized that methodology development must also focus not only on pure LCA issues, but also on application. In other words, the focus should be shifted from 'How to do LCA' towards 'How to use LCA'. The choice of the 'best' methodology is not necessarily a crucial point for success, but important is a meaningful application of LCA, which adapts pure methodology to the real world, copes with real industries, with real products, with real data, with conflicting interests and a large number of stakeholders from government, industry and academia.

Dr. Nobuo SONODA of Matsushita Electric Industrial Co., Ltd. explained about the activities to develop a standard for 'Sustainable Value Creation'. As a yardstick for sustainable value creation, 'Factor X tool' has been developed and applied as a criteria of Green Products/Services (GPs) since 2002 in his company. Factor X would also encourage customers to choose GPs to achieve the collaborative development of a sustainable society. Factor X tool was also applied to a model house to compare environmental impact caused by a single household in 1990 and 2003. While 'Quality of Life' (number of home appliances) increased 1.2 times from 1990 to 2000, the GHG emissions decreased by 40%.

Prof. Sanae HARA introduced herself as a representative of consumers, who has been interested in consumer affairs for 30 years and contributed to ecolabeling in Japan as well as to the ISO14000 series of standards. Consumers' awareness of environment has apparently increased, especially due to extreme weather consistent with global warming, like many strong typhoons coming to Japan this year. However, although many consumers want to purchase eco-products in their mind, few actions are actually observed. Little environmental information is available for consumers in purchasing goods, especially comparative information about products. Reliability of information is also an issue. Consumers tend to think that a 'pebble on the beach' will not make any differences, so that massive eco-action would be enhanced in the society.

Prof. Kitagawa added that Life cycle thinking may change the laws and systems in society, and the use of a 'manifest' for the enhancement of life cycle thinking would be quite useful.

Finally, Prof. Yasui concluded the panel discussion by clarifying the role of each sector. Government and scholars should show the final goal and the way to get there. Advance industries and scholars should be located half a step advanced in the way to the goal and lead (normal) consumers to the final goal. We should immediately suggest to citizens in society that Life-Cycle-Thinking should be one basic knowledge.

Closing Plenary Session

The Closing plenary session was chaired by Prof. Yasunari MATSUNO, chairman of the program committee for the 6th ICEB. The session consisted of three parts. The first was a ceremony of Poster Prize followed by the session summaries and the final remarks by Inaba.

Poster Prize
Amongst the total of 97 posters, four posters were awarded by Atsushi INABA on behalf of the Executive Committee. They were selected by voting based on content, explanation and presentation. The following posters were recognized with congratulations to the authors:

Best Poster Award: 'Application of Markov Chain Model for Analyzing the Average Number of Times of Use and the Average Residence Time of Elemental Iron in Society' by DAIGO et al., University of Tokyo.

Poster Awards:

- 'General Purpose Matrix Based LCA Software for Sensitivity and Uncertainty Analysis' by LU et al., University of Tokyo,
- 'Development of Site-specific LCA Method using Expanded Interregional Input Output Analysis' by YI et al., Yokohama National University and AIST,
- 'Optimal Schedules of Houses Construction for the Abatement of Greenhouse Gas Emissions: Novel LCA Methodology Considering Dynamic Socio-economic Constraints' by HONDO et al., Yokohama National University.

Session Summary

In the closing plenary, the three parallel sessions of the conference were summarized.

[Session 1] Dr. Norihiro ITSUBO of AIST summarized the session ***Life Cycle Assessment*** with a summary of one or two good presentations in each sub-session.

In the session of ***Risk analysis and others***, 'Environmental Impact of Urban Heat Island Phenomena' by Prof. SHIMODA et al. was presented and a cause-effect chain from human activities was identified.

In the session of ***Agriculture***, problems of LCA in this area were pointed out. Economic and social issues surrounding the continued existence of rural communities and farms are a critical consideration in assessing these activities. Prof. Guido HASS talked of the need to look at different impact categories and functional units in LCA. While product level assessments still have relevance, farm level assessment, and the incorporation of local impact categories need to be included if LCA is going to be useful to decision-making in these areas.

The ***LCI*** session had a higher share of international contributors (57%) as compared with other sessions. It showed that there are still many relevant issues in the LCI-Phase which need attention, further progress and application, because the LCIA can never be better than the underlying LCI.

In ***Advanced LCA Case Study-1***, the targets covered wide ranges from new copier technology to the whole balance of the waste. An assessment of CO_2 and energy savings associated with a new copier technology by HARADA et al., in which reduction of warm-up time of copiers showed significant reductions due to increased use of the standby mode. However, it was addressed whether trade-offs might exist for environmental issues other than energy and CO_2. The methodology to estimate the emission and the waste volume was especially discussed in this session, because the reduction of CO_2 emissions and the wastes in Japan are indispensable.

The new Japanese LCIA method LIME was a main topic of the ***Damage assessment*** session. Interesting details were provided by NAKAGAWA et al. regarding the development of an LCIA method to assess road transport noise impact based on vehicle-kilometers per vehicle-type. A comprehensive overview was given as an introduction to further present specific features, studies and approaches developed within the LIME framework. Uncertainty analysis of LCIA factors was another central subject throughout the session. A contribution from Switzerland presented the uncertainty assessment for toxicity characterization aimed at human health and ecosystem effects from the IMPACT 2002+ method to provide a straightforward and transparent way to screen uncertainties of characterization factors for several thousands of chemicals.

Advanced LCA Case Study-2 also showed a quite diverse scope of the topics addressed. Dr. FINKBEINER presented a very application-oriented approach for an effective and efficient LCI data collection procedure. MIZUISHI presented the study about the effect of the thermal insulation of houses on GHG emissions. The study was focusing on the leakage of fluorocarbons. The figures about the forecast of GHG emissions from all houses in Japan are highly suggestive to think of the effect of the insulation.

In the session of ***Database and Software***, characteristics of three national databases, i.e. ecoinvent of Switzerland, JEMAI of Japan and IMI, Chalmers of Sweden were presented.

There were five presentations in the session of ***Waste Management***, in which an approach to feasibility study of a wastewater treatment process using LCA results in a very early development phase was introduced.

[Session 2] Mr. Shigeyuki MIYAMOTO of NEC Corporation summarized the session ***Application of life-cycle thinking to analyses/assessment of technologies, products and services***.

There was variety of presentations from conceptual studies to practical application and algorithm in ***Material Flow Analysis*** session. One conceptual study on life cycle thinking and systems thinking was presented by Dr. HASHIMOTO et al., which discussed the way of combining LCA and MFA concepts with dynamic modeling approaches like system dynamics in order to support system thinking.

In the session for ***LCC***, Prof. HUNKELER outlined the drivers for LCC and explained the necessity of concentrating on money flows that are connected to a product's (including services) life cycle. External effects (e.g. environmental interventions), on the other hand, are better treated by LCA and other assessments. As a consequence, he suggested to not aggregate economic and other assessments, but rather to represent them in multi-

dimensional graphs as a basis for decision-making. Prof. Nakamura explained his research on basing the LCC on the inventory of a hybrid LCA that originates from the waste input-output LCA. This method, being of the 'Environmental LCC' type uses LCC as a second dimension to compliment LCA results. He showed how input-output LCA of recycling and waste treatment processes can be aligned with life cycle costing.

The session of ***Design for Environment*** reviewed the history, on various continents, of the policies, programs and tools for sustainability. It also highlighted numerous cases where eco-design combined LCIA and LCC, as well as social or consumer characteristics. Importantly, DfE, in firms, now seems to be carried out by non-environmental experts, illustrating that Japan is leading in the diffusion of the eco-balance concept. The cases showed impressive examples of how LCA could identify key metrics and these, then, be used to reduce dominant impacts. Innovations included work on assessing, and improving the service sector. An impressive contribution also recursively used LCA to define new physical-chemical specifications for materials.

There were 8 presentations in the ***Eco-Efficiency*** session. Prof. ZHU presented an introduction to the background, structure, scoring, indexes, and application of GOBAS (Green Olympic Building Assessment System). She enforced the estimation of some gymnasiums and office buildings using this system.

Ms. AOE presented information about the Household Factor. She developed 'Factor X Tool 2001', which compares both greenhouse gas and resources, and she compared a household in 2003 to 1990 in Japan. Results showed that it is possible to increase the 'quality of life' while at the same time reducing the environmental impact.

In the session of ***Ecomaterial***, Dr. HALADA reviewed the progress of eco-balance assessment of materials. Eco-efficiency of a material was proposed in hierarchical analysis. Social LCA was applied to a functional unit of eco-efficiency in iron. Problems of a lifetime and system boundary were discussed. Attributional description of material data was explained using TMR and resource-depletion parameters.

[Session 3] Prof. Hiroki HONDO (Yokohama National University) summarized twenty-nine oral presentations on the session ***Application of life cycle thinking to design-making by Governments, Enterprises and Consumers***, which consisted of four sub-sessions.

Presentations and discussions were mainly made from two points of view in the sub-session ***Decision Support Tools in Environmental Policy***. The first was about the development of tools and index to support decision-making by companies and governments considering real socio-economical conditions and/or contexts. It is important that tools for decision-making in environmental policy need to cover various aspects and should allow flexible modeling to describe the reality in suitable degree of detail. In this sense, the presentation by FUJII about a model for PET bottle recycling was impressive, tackling real problems of 'quality aspect of recycled PET' and 'costs' in decision-making within governments and industries. To summarize, the most prominent aspects for future researches are:

1) Multi-dimensional aspects (environment, cost, quality),
2) Dynamic or parameterized models (not only linear input output relations),
3) Aggregation of environmental impacts to single scores for decision-making.

In the second half of this sub-session, the use and interpretation of LCA results from viewpoints of LCA results, users were discussed. It was proposed that LCA community should start to really consider the users' needs, and the importance is to take a more consumer-oriented view and to communicate with the users of LCA results for further advanced LCA research.

In the sub-session ***Industrial Ecology***, the main topic was the spatial and temporal optimization of energy and material flows within a system. Practical and quantitative research concerning Eco-towns provided valuable discussions for applying LCA and MFA methodologies to regional policy decision-making. In addition, the importance is of integrating the recycling with the production of energy and basic materials (e.g. steel, plastics) as an optimal system was shown.

The sub-session ***Material Flow Cost Accounting (MFCA)*** had two presentations on theory of MFCA methodologies and six presentations about the application of MFCA to the production systems of companies in Japan. It was shown that it is significant for companies to consider the wider range of environmental cost, and MFCA could contribute to sustainable management of companies.

The sub-session ***Consumer Behavior and the Environment*** was composed of two parts. The first part had four presentations about analyses on households' behavior by way of two approaches, namely engineering system analysis and economic analysis. All the presentations included empirical results based on their own surveys and/or public statistical data. One of the topics was about environmental balance sheets to support environmentally sound actions of households. A collaboration of the engineering system approach and economic analyses would lead to an excellent environmental management system which would build a bridge between consumers and publishers of environmental balance sheets. In the second half, the main topics were consumer's behavior, decision-making and acceptability related to environmental impacts. All four studies performed interesting questionnaire/interview surveys to consumers and analyzed the actual responses. Discussions in this session mainly focused on the communication with consumers, e.g. how to present environmental information. Consequently, it was shown that consumers' behavior holds a significant key towards the construction of sustainable society.

At the end of the **closing session**, Dr. INABA made final remarks. Over the past six Ecobalance conferences, the participants have confirmed that LCA and its applications have broadened its scope. LCA is now being applied not only to products, but also to complicated social infrastructure, such as industrial symbiosis, ICT, recycling of materials. We should further make a progress in our research for designing sustainable society, in which dynamic, economic and social aspects should be taken into account with LCA (Life Cycle Thinking). Finally, Dr. Inaba announced that the **Seventh International Conference on Ecobalance** will be held in Tsukuba in 2006, in which the main scope will be 'LCA for Designing the Future Society' aiming at the further progress of Life Cycle Thinking.

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